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GLOBAL STATUS OF LARGE-SCALE INTEGRATED CCS PROJECTS

December 2011 update



Introduction and purpose

The Global CCS Institute tracks the global status of large-scale integrated CCS projects (LSIPs¹), through a regular review of news reports and updates from Institute representatives around the world. The public data set on LSIPs, maintained by the Institute, is amended on a weekly basis to reflect changes to the status and details of projects. In addition to this, the Institute is currently preparing its 2012 Annual Survey of LSIPs. The public data set is available [here](#). A map of CCS projects may be viewed [here](#).

The purpose of this paper is to summarise the present status of LSIPs and present a comparison with the results published in the Institute's [Global Status of CCS: 2011](#) report in October 2011.

Summary of recent project developments

The Global CCS Institute has identified 74 LSIPs around the world, including 15 that are currently operating or in construction, totalling a confirmed capture capacity of 35.4 million tonnes per annum (Mtpa) of carbon dioxide (CO₂). A further 59 LSIPs are in the planning stages of development, with an additional, potential capture capacity of more than 122 Mtpa.

Although the net number of LSIPs remains unchanged since the release of the *Global Status of CCS: 2011*, some significant changes have been made to the Institute's LSIP listings in the last quarter of 2011. Two relatively advanced European projects have been definitively cancelled, while two new projects were identified in China and the United States.

One LSIP that was not included in the *Global Status of CCS: 2011* entered construction; this project is the fourth to start construction since 2010. As we approach the end of 2011, it is worth noting and celebrating the fact that the confirmed CO₂ capture capacity of LSIPs in operation or in construction has increased by 7.6Mtpa since 2010, representing a 25 per cent increase in confirmed capacity in just over a year.

Cancellations in Europe – the importance of public support

The cancellation of the **Longannet Project** (Scotland) was announced in October 2011, following a decision by the UK Government not to fund the construction of the project. Results of the front end engineering design (FEED) study were made available on the UK Department of Energy and Climate Change's [website](#).

The **Vattenfall Jämschwalde** (Germany) project was also cancelled in December 2011, due to a lack of progress in resolving regulatory issues around CCS in Germany, particularly with respect to the permanent sequestration of CO₂ underground.

Although neither of the decisions came as a surprise, these cancellations remain a set back for the deployment of CCS technology in Europe, and they have several things in common.

- Both Longannet and Jämschwalde were early-mover power generation projects in the advanced stages of development, that had successfully tackled a number of technical hurdles.
- Both had received substantial public financial support to reach that point (Longannet was one of the two projects selected by the UK Government's DECC under the first round of the UK CCS Demonstration competition, and was awarded GBP 45 million, while Vattenfall's Jämschwalde received EUR 180 million from the European Commission as part of the European Energy Programme for Recovery).
- Both projects intended to update large, high-emitting power plants and were on the way to demonstrate the applicability of low-emission technology to conventional coal-fired plants.
- Significant lessons can be learnt from each; indeed the UK Department of Energy and Climate Change has already released results of the Longannet FEED study.

There are also obvious differences. At Longannet, it was commercial issues that caused the project to halt, whereas the Jämschwalde project faced opposition from the local community towards the chosen storage site, exacerbated by the lack of a clear, policy-driven regulatory framework.

The UK Government remains committed to supporting CCS projects. As the UK Department of Energy and Climate Change said, a decision had been made "not to proceed with Longannet", but instead spend the GBP 1 billion earmarked for Longannet on other CCS demonstration projects. While re-affirming CCS was a

¹ LSIPs are defined as those projects which involve the capture, transport and storage of CO₂ at a scale of not less than 800,000 tonnes of CO₂ annually for a coal-based power plant – or not less than 400,000 tonnes of CO₂ annually for other emission-intensive industrial facilities (including natural gas-based power generation).



“key technology for the UK’s long-term energy strategy”, Secretary of State for Energy and Climate Change Chris Huhne said “a billion pounds is enough to demonstrate this vital new technology in the UK”, adding the money needed to be spent in the “most effective way” possible.

There are now no LSIPs in Germany. It is likely that companies will require positive developments to occur in the policy and regulatory environment before investing in new CCS projects in Germany. However, a number of German companies are involved in the development of CCS projects, with various roles, and some of them are seriously considering investing in LSIPs, especially in the Netherlands. Current examples include the Rotterdam Opslag en Afvang Demonstratieproject (ROAD) and the Pegasus Rotterdam project, with E.ON and LindeGas considering investment respectively.

Progress and expansion of EOR – driven projects in the United States

The [Air Products Steam Methane Reformer EOR Project](#) entered construction in August 2011 and the project was subsequently moved to the Execute stage of the asset lifecycle. According to Air Products’ statements, the new-build hydrogen plant could be operational as early as 2012, delivering around 1 Mtpa of CO₂ to enhanced oil recovery (EOR) operators.

Initial CO₂ capture plans at [NRG Energy’s Parish](#) power plant were recently expanded and the project now meets the criteria for inclusion into the Institute’s list of LSIPs. The process stream with CO₂ capture was expanded from 60 MWe to 240 MWe, while the volume of CO₂ to be captured at the plant was increased from 375,000 tpa to 1.5 Mtpa. The scale-up of the NRG Energy project occurred as a response to the demand in the enhanced oil recovery market for larger volumes of CO₂. The project, relatively advanced, is at the Define stage with FEED studies nearing completion and a permitting process under way. Final investment decision (FID) is expected to occur by the end 2012, and the project is scheduled to come on line in the first half of 2015.

Both projects illustrate the trend of the CCS market in the United States, largely driven by the maturity and predictability of the EOR market in the country, notably in Texas, where both the Air Products and the NRG Energy projects are located.

The Air Products project is the fourth LSIP to commence construction since 2010, following the [Boundary Dam Integrated Carbon Capture and Sequestration Demonstration](#) project, the [Lost Cabin Gas Plant](#) and ADM’s [Illinois Industrial Carbon Capture and Sequestration \(ICCS\)](#) project. All of these newly confirmed projects are found in North America and, with the exception of ADM’s ICCS project, they are also linked to EOR operations.

North America accounts for more than 80 per cent of the global, confirmed CO₂ capture capacity through large-scale CCS projects, while the United States alone accounts for around 68 per cent. This representation is likely to remain high in the medium term, as North America also accounts for more than 50 per cent of the potential CO₂ capture capacity of LSIPs in development – with 44 per cent just in the United States.

A newly identified LSIP in China

The [Datang Daqing Oxy-fuel Combustion CCS Demo Project](#) was added to the Institute’s LSIP listing in December 2012.

Datang Heilongjiang Power Generation Co. Ltd (a subsidiary of China Datang Corporation) is developing a new-build super-critical coal-fired power plant near Daqing city in Heilongjiang province. Around 1 Mtpa of CO₂ would be captured through oxy-fuel combustion from one of two 350 MWe Cogeneration of Heat and Power units at the plant. Options for the storage of CO₂ include deep saline formations and the use of CO₂ for enhanced oil recovery in nearby oil fields.

A feasibility study agreement was signed in November 2011 between Datang and Alstom to develop the oxy-fuel combustion unit. The project is expected to start operation in 2015.

Miscellaneous

In September 2011, SCS Energy finalised the purchase of the [Hydrogen Energy California \(HECA\)](#) project in the United States. Most elements of the project remain unchanged. The main alteration made to the original plans is the addition of fertiliser manufacturing. The new polygeneration system allows the hydrogen produced at the integrated gasification combined cycle (IGCC) plant to be used to produce electricity at peak hour, and fertiliser at other times. The volume of CO₂ to be captured from the IGCC plant was slightly increased from around 2 Mtpa to more than 2.3 Mtpa, while the expected operation date was slightly delayed by one year to 2017.



Starting from 2014, CO₂ capture and injection capacity at the [Sleipner CO₂ Injection](#) project will be expanded from 1 Mtpa to 1.1 - 1.2 Mtpa². Natural gas produced from the Gudrun field (currently under development) will be sent to the existing Sleipner T platform for removal of excess CO₂. Unprocessed natural gas in the Sleipner West area typically contains about 9 per cent CO₂, and concentration levels are reduced to 2.5 per cent at Sleipner T to meet export and customer specifications. The CO₂ captured is then re-injected into a deep saline formation above the reservoir zone.

A Record of Decision (ROD) was issued by the United States' Department of Energy regarding the funds allocated to the [Texas Clean Energy Project](#) in October 2011. This ROD is the final step in the National Environmental Policy Act (NEPA) permitting process and allows public funds previously allocated to the project to be spent beyond engineering and design studies. This indicates the project is very close to making a final investment decision, which is expected in early 2012 with project construction to follow.

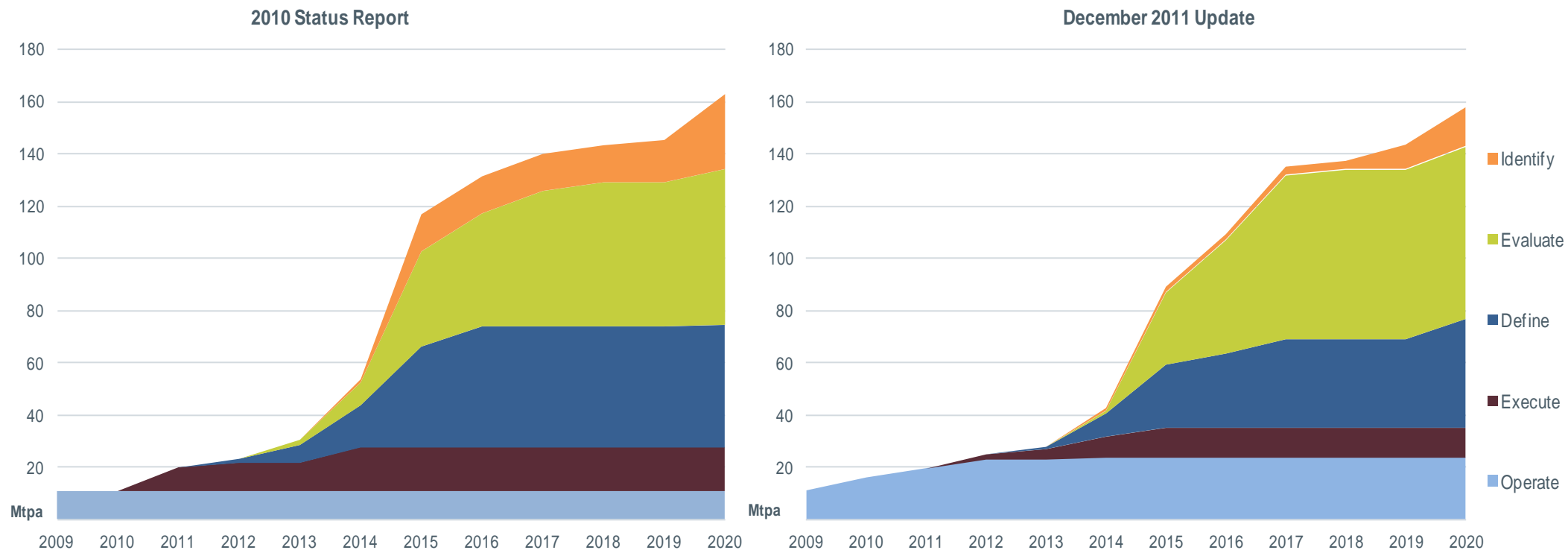
On 5 December, the Spanish Fundación Ciudad de la Energía (CIUDEN) announced it had, for the first time successfully tested oxy-combustion in a 30 MWth circulating fluidised bed (CFB) boiler. This is a significant milestone towards the development of commercial-scale applications of the oxy-combustion technology, and a very positive development for CIUDEN's large-scale [OXYCFB 300 Compostilla Project](#). CIUDEN's press release on the testing can be found [here](#).

² The originally posted December note indicated an expansion to 1.7 Mtpa. The Institute has since been advised that the volume had been revised down to 1.1 - 1.2 Mtpa.



APPENDIX 1

Overview of project progress in 2011 – A 25 per cent increase in confirmed capture capacity



There are now 15 LSIPs operating or in construction, with a combined CO₂ capture capacity of 35.4 million tonnes per annum (Mtpa) – roughly equivalent to the current annual emissions of the Slovak Republic or Norway. This confirmed CO₂ capture capacity has increased by more than 7 Mtpa since the Institute’s 2010 survey, representing a 25 per cent increase in the space of just over a year.

Meanwhile, project cancellations in 2011 resulted in a loss of around 25 Mtpa in potential capture capacity for projects in development. Five projects at the Define stage (10 Mtpa of CO₂) were cancelled, as well as four smaller projects in Evaluate (6 Mtpa) and three larger projects at the Identify stage (9 Mtpa). Cancellations were almost compensated by the identification of 10 new LSIPs, representing just more than 24 Mtpa in capture capacity.



APPENDIX 2

Main changes to large-scale integrated CCS projects listings

(December 2011 Update vs *Global Status of CCS: 2011*)

Cancelled Projects			
Europe Area	Longannet Project	2 Mtpa	Considered cancelled – project was shelved following announcement by the UK Department of Energy and Climate Change that it would not fund the construction of the CO ₂ capture facilities.
	Vattenfall Jämschwalde	1.7 Mtpa	Considered cancelled – plans were stopped, citing the lack of government support and the absence of a clear legal framework.
Newly-Identified Projects			
China	Datang Daqing Oxy-fuel Combustion CCS Demo Project	> 1 Mtpa	New build super-critical coal-fired power plant generating electricity and heat, with oxy-fuel combustion CO ₂ capture. Operation is expected to start in 2015.
United States	NRG Energy Parish CCS Project	1.5 Mtpa	Retrofit of post-combustion CO ₂ capture technology at a coal-fired power plant in Texas. The CO ₂ will be used for enhanced oil recovery starting from 2015.
Project Progress			
United States	Air Products Steam Methane Reformer EOR Project	1 Mtpa	Moved to Execute as it started construction in August 2011 – the new build hydrogen plant is expected to begin operation in 2012.
Other key changes			
Europe Area	Sleipner CO ₂ Injection	1.1 to 1.2 Mtpa	Volume of CO ₂ captured and injected will be expanded to 1.1 - 1.2 Mtpa in 2014, with the addition of 0.1 to 0.2 Mtpa of CO ₂ from the gas produced from the Gudrun field, currently under development.
United States	(HECA) Hydrogen Energy California Project	2.3 Mtpa	Purchased by SCS Energy. The hydrogen plant was requalified as a polygeneration plant and will include the manufacturing of urea. Expected operation date was moved back by one year to 2017.